Introductions of non-native fish into the subbasin include sunapee char, arctic grayling, golden trout, lake trout, brook trout and non-indigenous rainbow trout. These fish have been introduced into high mountain lakes, lowland lakes, rivers and streams (USDA FS/BLM, 1998). Brook trout are widely distributed and are found in many tributaries within the subbasin (DEQ, 1999a). In this subbasin, brook trout prefer small tributaries and are not found in the mainstem Salmon River. Brook trout tend to dominate the lower elevation reaches and native trout stay in higher elevation reaches. In 1995, Valley Creek fish surveys produced high percentages of brook trout. Also, some mountain lake systems (lakes and inlet/outlet streams) are dominated by brook trout.

Recent sampling associated with DEQ's large river Beneficial Use Reconnaissance Project (BURP), monitoring of aquatic life in Idaho's streams, resulted in collection of multiple age classes of salmonids as well as several sculpin and dace species, largescale sucker, chiselmouth, northern pikeminnow, and redside shiner (Table 2).

Table 2. Large river BURP fish collections in 1999.

Location	Fish Collected	Age Classes
Salmon River near Obsidian (passes 1 and 2 combined)	19 brook trout, 10 cutthroat trout, 18 shorthead sculpin,	Trout ages = 4 Salmonid ages = 4 Sculpin ages = 4
Salmon River at Yankee Fork near Clayton	8 chinook, 40 mountain whitefish, 3 rainbow trout, 2 mottled sculpins, 62 shorthead sculpin, 3 longnose dace	Trout ages = 2 Salmonid ages = 6 Sculpin ages = 5
Salmon River at Pahsimeroi River near Challis	16 chinook, 73 mountain whitefish, 6 rainbow trout, 53 mottled sculpin, 2 shorthead sculpin, 25 largescale sucker, 1 chiselmouth, 2 longnose dace, 1 northern pikeminnow, 8 redside shiner, 8 speckled dace	Trout ages = 3 Salmonid ages = 6 Sculpin ages = 4

Other native fish include the Pacific lamprey, once abundant where anadromous host fish resided (DEQ, 1999a). The presence of white sturgeon in the Salmon River is documented as recent as 1996 by the Salmon-Challis NF.

SUB-WATERSHED DESCRIPTIONS

The sub-watershed boundaries used in this subbasin assessment are those depicted in Figure 6. Sub-watershed descriptions are based on descriptions of drainages provided by various resource agencies and documents. Often sub-watershed boundaries differ from agency to agency and from document to document. Thus, data are often less than precise when different boundary conventions can affect various measurements such as area estimates. These descriptions lay the foundation for discussions of specific water quality concerns and water quality-limited waters in the next section and are intended to be introductions to specific watersheds within the subbasin.

The Salmon River Corridor (303d listed for sediment and temperature)

The mainstem Salmon River is described as a large, powerful river capable of moving large amounts of sediment naturally produced by snowmelt runoff and thunderstorm events in its tributaries. The floodplain has been modified considerably by conversion to cropland. Riverbanks have been altered by the construction of numerous dikes and diversions associated with residential development, agriculture and state highway 75 and 93. Much of the natural sinuosity of the river has been reduced in an effort to protect residential and agricultural lands on either side of the river channel. Recreation, especially river floating in rafts and drift boats, is an increasing use of the river corridor. There are eight developed campgrounds in the reach from the headwaters to Holman Creek as well as several day use areas and river boat access facilities (SNRA, 1996). From Holman Creek to the confluence with the Pahsimeroi, on BLM administered land there are three developed campgrounds.

Soils throughout much of the canyon are derived from Challis volcanics, quartz monzonite, sedimentary limestone, and quartzite (USDA FS, 1999a). From the standpoint of sediment production, the poorly cemented silt, sandy silt, and bentonite fractions of the lakebed sediments and deposits of glacial till are probably the most prolific sediment sources to the river (USDA FS, 1999a). An additional source of sediment is the residual deposits of highly weathered material held on steep canyon walls and elevated terraces which is mainly derived from Challis Volcanic rhyolite or Idaho Batholith granitic material that can be washed down in heavy thunderstorms.

The Salmon River canyon from Peach Creek to Basin Creek is a classic V-shaped canyon with steep side walls. Geologic scour has left the small tributaries hanging, forming steep cascades as they plunge into the river (SNRA, 1999c). Upstream from Basin Creek to the Salmon River headwaters, the river extends through a fault-bounded valley once filled with wet meadows remnant of glacial outwash plains. Historic stream flow records (Appendix G) show annual peaks near Obsidian vary from 300 cfs to 650 cfs. Further downstream near Stanley annual peaks are from 1,500 cfs to 5,700 cfs (USGS, 2000).

The Salmon River from Peach Creek to the East Fork Salmon River drops in elevation from about 6,100 feet to 5,400 feet with an average gradient of less than 1% (USDA FS, 1999a). Mainstem baseflow is estimated to be around 500-800 cfs, and channel types are again Rosgen B-type in canyons and C-type in flatter areas. Although most of the private land in the valley bottom is in agricultural use, more and more of it is being converted to residential uses. Riparian and floodplain areas have been highly modified by agricultual activities and bank stability structures associated with State Highway 75 including riprap, rock and log barbs, and in some cases levees.

The Salmon River from the East Fork Salmon River to the Pahsimeroi River drops in elevation from 5,400 feet to 4,620 feet. Gradients are generally less than 4% and channel types are a mix of Rosgen B-types through canyon areas and C-types in flatter, often agricultural areas (USDA FS, 1999b). Through this stretch, the river flows generally in a fairly narrow, rocky canyon except in the vicinity of the city of Challis where it opens up

into a broad valley from one to three miles wide. North of Challis, the river re-enters a canyon configuration to the Pahsimeroi River. Mainstem baseflow is estimated to be around 1,000 cfs (USDA FS, 1999b).

Warm Spring Creek Sub-watersheds (303d listed for nutrients and sediment)

Lone Pine Creek and Broken Wagon Creek

The Warm Springs drainage parallels the Pahsimeroi River drainage with the Lost River Mountain Range separating the two drainages. Warm Spring Creek is on the north end of the divide with the Big Lost River drainage. These two sub-watersheds are considered together as they both make up the Warm Spring Creek drainage. This drainage is located about 3 miles south of Challis on the south side of the Salmon River. Approximately 50 m below its spring source Warm Spring Creek is diverted in it's entirety through an aquaculture operation. The effluent from the aquaculture operation then enters a ditch that ultimately supplies a hydroelectric project over a mile down-gradient. Outfall from the hydroelectric project continues through a system of agricultural ditches that do not return water to the natural stream channel. Historically flow from Warm Spring Creek would infiltrate and not reach the Salmon River as surface water.

The two sub-watersheds together include 61,425 acres with most of the area in federal ownership (36,075 acres in BLM; 16,650 acres in Forest Service), 6,750 acres in private, and 1,950 acres in State ownership (USDA FS, 1999b). Private ground is found throughout the valley on both sides of Warm Springs creek. The principle use of private land is agricultural, including aquaculture, irrigated cut hay, and pasturing. The remaining lands are used primarily for livestock grazing.

Warm Spring Creek is geothermal and water temperatures exceed 20^{o}C throughout its length (USDA FS, 1999b). Upstream of the diversions warm water fish (tilapia, largemouth bass, and catfish) have been introduced and are reproducing naturally. Because the sub-watersheds are isolated from the Salmon River, there is no potential for migrating salmonids to enter this system.

Figure 6. Upper Salmon River Subbasin 5th Field HUCs.

Mainstem Salmon River Sub-watersheds

Morgan Creek

The Morgan Creek sub-watershed is the northernmost sub-watershed in the subbasin (Figure 5 and Figure 16). Morgan Creek enters the Salmon River from the north side about midway between Challis and the Pahsimeroi River. The sub-watershed includes 77,305 acres of land under federal and private ownership (USDA FS, 1999b). Portions of valley floors are in private irrigated agricultural use.

Morgan Creek is a typical central Idaho mountain stream with annual peak flow driven by snowmelt runoff. Average annual flow at the confluence with the Salmon River is 35.6 cfs, with an average peak flow of 278 cfs, and an average low flow of 6.2 cfs (USDA FS, 1999b). Approximately 60% of the annual flow occurs in May and June. Morgan Creek has a narrow riparian corridor heavily vegetated by cottonwoods and willows. Sediment in Morgan Creek varies from small suspended sediment to cobble size substrate. Elevations range from 9,700 feet to 5,200 feet.

Bank stability ratings in 1995 – 1997 were generally above 80% for three out of four monitoring stations on Morgan Creek, but were 50 – 64% at one station on Morgan Creek below Trail Creek. Trail Creek apparently suffered a "blow out" of some beaver dams which has affected downstream reaches. Percent fines by depth were also measured at these sites in 1995-1997. Fines varied from 23 to 42 % depending on year and location. Depth fines have decreased at three out of the four stations over the three-year period.

The principle uses in the sub-watershed are grazing, agriculture and dispersed recreation. There have been small timber sales on Forest Service land. There are numerous unscreened agricultural diversions that have been in place since the late 1800's. Currently, there are 23 water rights claims for 49.01 cfs during March 15 through November 15 on Morgan Creek (USDA FS, 1999b). During the irrigation season, Morgan Creek can be dewatered before it reaches the Salmon River. There is a large diversion above Corral Creek that dewaters a portion of Morgan Creek. Morgan Creek flow is recharged again by flow from Corral Creek.

The County Road that parallels Morgan Creek through much of it's course, particularly where the valley narrows appears to constrict the stream through fill slope. This constriction may be a source of instability downstream.

Ellis Creek

The Ellis Creek sub-watershed includes Ellis Creek and Spring Gulch on the west side of the Salmon River just south of the town of Ellis, and a number of small drainages on the east side of the Salmon River including Shotgun Creek, Shep Creek, Dry Gulch, and Penal Gulch. Very little information is available on these streams. They are small and intermittent, and some are dewatered by agricultural diversions.

Challis Creek and Mill Creek (303d listed for nutrients, sediment, flow alteration)

Challis Creek and Mill Creek sub-watersheds are considered together here because streams in the Mill Creek sub-watershed are tributary to Challis Creek. The Challis Creek Watershed area is 75,147 acres. Challis Creek originates in near vertical headwall cirque basins carved out of Challis Volcanics at elevations near 10,000 feet. The topography becomes more gently sloped benches and bottomlands at lower elevations. The hydrology is typical of central Idaho mountain streams with high flows in May and June from snowmelt runoff and low flows during winter months. Flows may increase temporarily due to local summer thunderstorms. Historic stream flow records (Appendix G) show peak discharges varying from about 140 cfs to as high as 800 cfs (1965), although most years are below 250 cfs. Channels in the upper sub-watersheds are relatively narrow and steep with gradients generally greater than 4% and some above 10% (USDA FS, 1997b). Stream gradients from the Forest boundary to Mosquito Flat Reservoir range from 4 –5 % (USDA FS, 1999b). Channel types are typically Rosgen A- and B-type above the confluence of Bear Creek. There is evidence of alternate widening with aggradation above the Forest Service boundary from the Forest Road crossing below Mosquito Flat Reservoir downstream to the confluence of White Valley Creek. Further downstream gradient is less. On private property downcutting becomes apparent below a debris dam that blew-out. Historic severe overgrazing has influenced the Challis Creek Channel and associated riparian vegetation. Annual flood stage was described as 160 cfs and annual yield was 40 cfs (USDA FS, 1997b).

Aquatic habitat was surveyed by the Forest Service in 1993 using R1/R4 protocol (USDA FS, 1997b). Tributaries to Challis Creek within the Forest boundaries were considered good to excellent quality. However, Challis Creek proper immediately above the Forest boundary was identified as having poor water quality with: elevated bedload sediment, poorly defined channels, and excessive erosion and sedimentation, elevated suspended sediment, poorly oxygenated water, and unstable banks.

Observations by DEQ and affiliated contractors have noted a significant landslide below the Mosquito Flat reservoir that has not been stabilized by natural processes or land management best management practices. This feature may have resulted in channel aggradation that subsequently reduced streambank stability, which resulted in increased deposition down stream. Beaver activity just below the confluence of Bear Creek and Lodgepole Creek has produced dams that have stored sediments over many years. Channel aggradation from increased bedload and sedimentation has filled beaver dams and resulted in the stream cutting around the beaver impoundments. This process appears to be having an impact on channel dynamics as a result of heavy sediment and bedload deposition.

Challis Creek watershed contains good populations of resident rainbow trout, cutthroat trout, whitefish and sculpin (USDA FS, 1997b). Steelhead have also been found in the lower sections of Challis Creek, although no spawning and rearing areas occur above the Forest boundary. Brook trout, introduced in the 1950's, have established naturally reproducing populations in a variety of locations. Bull trout, once thought to be both

migratory and resident life history types, are now restricted to small resident populations in headwater areas. Challis Creek was identified as critical habitat for chinook salmon, although no spawning or rearing salmon have been seen in the watershed for the last 20 years (USDA FS, 1997b).

The two sub-watersheds total 75,150 acres and have 105 miles (0.89mi/mi^2) of road and motorized trails (USDA FS, 1997b). The majority of the sub-watersheds are in dense forest (65%) with sagebrush openings making up an additional 26%. Grazing and recreation are primary uses. There are two developed campgrounds at Mosquito Flat Reservoir and Mill Creek Campground, and a number of other primitive camping areas (USDA FS, 1999b). Below the Forest boundary most of the land surrounding Challis Creek is private and in agricultural uses. A dam creating Mosquito Flat Reservoir was built in 1950 for the purpose of irrigation water storage. This reservoir has been maintained as year-round storage since the 1970's. Though reservoir operations prior to1970 are not documented, the potential exists for historic detrimental effects to the Challis Creek stream channel from sudden water release affiliated with storm events, debris dams at the reservoir outlet and snow-melt driven extreme hydrologic events. A debris dam was noted in April, 2002 that raised the lake level by over 12 inches. Sudden release of this water could result in significant erosion. It may be possible that the landslide below Mosquito Flat reservoir was triggered by such an event.

There are numerous diversions for irrigation on Challis Creek and Mill Creek (USDA FS, 1997b). Middle and lower reaches of Challis Creek are frequently dewatered. Challis Creek Lakes, Spruce Gulch, and West Fork Creek also have water storage structures to enhance irrigation (USDA FS, 1999b). According to the Idaho Department of Water Resources (IDWR) records, there are over 80 water rights for Challis Creek water. Most rights are for less than 1 cfs flow each.

Garden Creek (303d listed for nutrients and sediment)

The Garden Creek sub-watershed is approximately 50,000 acres in surface area and is located directly above the city of Challis, Idaho. This sub-watershed is often considered with Challis Creek because of their similarities of geology, soils, and hydrology (USDA FS, 1999b). Garden Creek, however, is relatively small and has no perennial tributaries. Stream gradients can vary from 5% to greater than 10%. Garden Creek flows directly through the city of Challis, and supplements the municipal water supply for the city during some summer months. The stream channel below the USDA FS boundary has been extensively altered and channeled, particularly within the City of Challis.

The land area on both sides of Garden Creek below the National Forest boundary is entirely private. Much of this land is used for irrigated agriculture and residential development. There are approximately 46 water rights claims for Garden Creek water including the city's drinking water supplementation. Collection of drinking water is achieved through an infiltration basin or gallery buried below a sand filtration layer below the stream channel. The water is made safe for drinking by further filtration away from the stream channel. Challis drinking water is known to be of high quality and there

have been no water quality issues identified in periodic testing to maintain certification by DEQ. In addition to habitat alteration from streamside development Garden Creek is frequently dewatered above the City of Challis (IDWR data). Several site visits by DEQ during the 2000 and 2001 field seasons confirmed this to be true from just above the City boundary to well below the City. Within the City limits the streambanks are stable but highly channeled with riprap. Above the City of Challis BURP scores are above the full support thresholds and fisheries data show full support of the salmonid spawning beneficial use.

Keystone Mine consists of shafts and adits and it exists on the northeast flank of Keystone Mountain above Keystone Gulch just inside the National Forest boundary. The mine was in production from 1882 through 1930 producing 4,700 oz of Silver, 2,400 lbs. of copper, and 3,800 lbs. of lead. Elements associated with various minerals found at the Keystone mine include fluorine, beryllium, silver, lead and copper. Lead, copper and zinc are also affiliated with other area mines (Chambers, 1966). It appears uncertain as to where the materials were milled. Given the low quantities of product the materials may have been milled off site or there may have been a mill site positioned downslope of the mine in the ephemeral drainage of Keystone Gulch. The mine is located at approximately 8,000 ft elevation approximately 0.3 miles west of Keystone Gulch. There is no data available that indicates that the Keystone mine has had an impact on water quality in Garden Creek. Garden Creek is in full support of beneficial uses above and below Keystone Gulch to just above the City of Challis, where the stream is periodically dewatered.

The principal land use within the watershed on Forest Service and BLM land is grazing. Much of the private land is used for irrigated pasture and feed production.

Bayhorse Creek

The Bayhorse Creek sub-watershed is a large section that includes Bayhorse Creek and a number of smaller face drainages to the Salmon River between Garden Creek and the East Fork Salmon River. Some of the smaller drainages included are Birch Creek, Rattlesnake Creek, and Lyon Creek on the west side of the Salmon River, and Malm Gulch and Bradshaw Gulch on the east side of the Salmon River.

The west side watersheds including Bayhorse Creek, Birch Creek, Rattlesnake Creek, and Lyon Creek total about 41,607 acres in size (Bayhorse Creek) (USDA FS, 1999b). Elevations on the west side range from 10,072 feet on Bald Mountain to about 5,200 feet. Bayhorse Creek originates in Bayhorse Lake and flows downstream with gradients from 8% to almost 20% in Rosgen A and B channels. The lowest reach near the mouth has gradients around 3-4%. Birch Creek, Rattlesnake Creek, and Lyon Creek have gradients generally around 10%. Bayhorse Creek flow varies from 1 cfs to over 70 cfs. Stream banks are stable and generally well shaded (USDA FS, 1999b). Water temperatures are consistently low and remarkably stable (between 9^{o} and 14^{o}C from July 1 to September 30, 1997) (USDA FS, 1999b). Other fish habitat parameters are generally in excellent condition. Steelhead are known to be present in Bayhorse Creek.

The Bayhorse Creek watershed has a history of mining activity including Skylark Mine, Ramshorn Mine, Pacific Mine, and Riverview Mine among others. No mines are currently active and no reclamation has occurred. The possibility of heavy metal leaching exists (USDA FS, 1999b). There are three water rights claims totaling 8.5 cfs on private land (USDA FS, 1999b). These rights include the entire summer flows of Bayhorse Creek. Other uses in the watershed include grazing, recreation (including Bayhorse Lake Campground), residential and agricultural. Logging occurred in the valley bottoms fairly agressively until the late 1950's (USDA FS, 1999b).

Spud-Sullivan (Kinnikinic Creek 303d listed for unknown)

The Spud-Sullivan sub-watershed includes Spud Creek and Sullivan Creek on the south side of the Salmon River and Kinnikinic Creek on the north side of the Salmon River between the East Fork Salmon River and Squaw Creek. Spud and Sullivan Creeks are primarily in federal ownership with 8,640 acres of Forest Service land, 4,480 acres of Bureau of Land Management (BLM) land, 1,280 acres of State land, and 40 acres of private land (USDA FS, 1999a). The Kinnikinic Creek drainage has 4,350 acres of Forest Service land, 4,280 acres of BLM land, and 320 acres of private ground.

The estimated mean annual flow for Spud and Sullivan Creeks combined is less than 2 cfs (USDA FS, 1999a). Sullivan Creek is affected by a water diversion on private land in the lowest reach. Gradients are generally over 4% with channel types predominantly Rosgen A- and B-type channels. Elevations vary from 8,500 feet to 5,300 feet on the Spud/Sullivan side of the Salmon River. A small, natural lake located at the headwaters of Sullivan Creek is stocked on a regular basis with cutthroat trout by the Idaho Department of Fish and Game. There are no bull trout present in either Spud Creek drainage or Sullivan Creek drainage (USDA FS, 1999a).

Livestock grazing is the dominant land use within the Spud and Sullivan drainages. There are grazing allotments on federal land and private land is used for residential homes, cultivated fields, or livestock grazing. Mining and recreation are also major uses in the Kinnikinic Creek drainage(USDA FS, 1999a).

Kinnikinic Creek has seven small perennial tributaries on Forest Service land and an estimated mean annual flow between 5 and 10 cfs (USDA FS, 1999a). Gradients are generally over 7% with a predominance of Rosgen B channel types, although there are some A-type channels in tributaries with gradients as high as 25%, and C-type channels near the mouth of Kinnikinic Creek. Elevations on the north side of the Salmon River vary from 9,400 feet to 5,700 feet. Kinnikinic Creek was previously affected by patented mining claims associated with the Clayton Silver Mine and Mill complex (USDA FS, 1999a). Tailings piles are directly adjacent to the creek. Tailing piles were subject to wind and water erosion with deposition directly into Kinnikinic Creek. After being investigated for possible clean-up action by EPA in 2000, tailings were capped to prevent wind and water erosion. Tailings piles were re-sloped and seeded to further aid erosion reduction. The Kinnikinic Creek channel was re-constructed away from the tailings in 2001 to reduce erosion into the tailings. Historically the operation of the mill diverted the

water from Kinnikinic Creek into a pipeline that led to a hydroelectric power facility downstream which prevented fish migration due to dewatering the stream channel, when in operation. The hydropower diversion was discontinued in 2001 and no longer dewaters the stream channel. There is also a migration barrier at the culvert under Highway 75 near the mouth of Kinnikinic Creek. This culvert barrier is being evaluated for replacement to allow fish passage from the Salmon River into Kinnikinic Creek. Until this barrier is made passable Kinnikinic Creek will be isolated from anadramous and migratory fish. There are bull trout present in Kinnikinic Creek (DEQ, 1999a). Bull trout are found in the following Kinnikinic Creek tributaries: Happy Hollow, Broken Ridge, and Sawmill Creeks as well as Transfer, Corral, Cabin and Coal Creeks (DEQ, 1999a).

Squaw Creek (proposed 303d listed for temperature)

The Squaw Creek sub-watershed is located on the north side of the Salmon River west of the town of Clayton. The sub-watershed includes Squaw Creek and numerous smaller tributaries on predominantly federal land. There are over 41,000 acres of Forest Service land, 10,667 acres of BLM land, 433 acres of State lands, and 1,534 acres of private land (USDA FS, 1999a). Squaw Creek has a mean annual flow of about 20 cfs, and gradients are over 4% with a predominance of Rosgen B-type channels. There are A-type channels in headwaters and C-type channels near the mouth of Squaw Creek. Elevations within the sub-watershed vary from 8,200 feet to 5,570 feet. Squaw Creek and one of its tributaries, Martin Creek, have bull trout present in them (USDA FS, 1999a).

The primary activity within the sub-watershed is associated with mining, followed by livestock grazing, irrigated pasture and recreation (USDA FS, 1999a). The Thompson Creek molybdenum mine sits on the watershed divide between several drainages contributing to Thompson Creek and Bruno Creek, a major tributary to Squaw Creek. There is an all weather haul road to the mine that traverses the ridge between Thompson Creek and Squaw Creek. A large mine wastewater tailings impoundment is located on Bruno Creek. Thompson Creek Mine has three NPDES discharge outfalls, two in the Thompson Creek drainage and one to Bruno Creek, a tributary to Squaw Creek (Mebane, 2000). Thompson Creek Mine has been in the process of renewing their NPDES permit and additional outfalls are being proposed, one to Squaw Creek and one to the Salmon River. The Environmental Protection Agency has completed the final draft of the NPDES permit and issuance is expected in January of 2002. Extensive studies have taken place and metals monitoring has occurred above and below discharge points. According to Mebane (2000) clean metals monitoring in the Squaw Creek drainage indicated that no criteria violations occurred in Squaw Creek below the mine discharge, however, there may be some elevated lead concentrations above the mine in sediments. There are other mines for lead and silver in the Squaw Creek drainage primarily below the Forest Service boundary surrounded by BLM and State land. These mines have operated periodically from the late 1800s to as late as 1976.

A road parallels the mainstem of Squaw Creek from its mouth to its headwaters with a number of spur roads accessing old timber sale sites and old mine sites throughout the

sub-watershed. There are five diversions, which have dewatered the stream in the past, near the mouth of Squaw Creek, used primarily for agricultural activities (USDA FS, 1999a). The diversion dam acts as a fish migration barrier. The lowest reaches (3.5 miles) of Squaw Creek are bordered by private land, with mostly agricultural and residential use.

There is some potential that the lower portion of Squaw Creek is influenced by geothermal activity. Elevated stream temperature can result from the combined effect of flow alteration and geothermal inflow.

Thompson-Slate (Thompson Creek 303d listed for metals, sediment)

The Thompson-Slate sub-watershed includes the Thompson Creek drainage on the north side of the Salmon River and the Slate Creek watershed on the south side. A number of smaller face drainages are included in this sub-watershed including Peach, Treon, Gardner, Burnt, Beaver, Badger, Mill, Holman, and French Creeks.

Thompson Creek has a mean annual flow of about 18 cfs (1973-1999 data, see Appendix G) and a base flow near 2 cfs (USDA FS, 1999a). Minimum and maximum daily mean flows for Thompson Creek are 1.4 cfs (1979) and 373 cfs (1997), respectively. Upper Thompson Creek on Forest Service land is generally steep with an average gradient near 5%. The lower half, which is bordered on the east side by BLM land and Forest Service land on the west side, has an average gradient near 3%. Elevations range from 9,600 feet to 5,580 feet. Thompson Creek contains bull trout and all other known species in the area (USDA FS, 1999a). An improved dirt road parallels Thompson Creek, mostly in the riparian area, for most of its length. Short spur roads to access timber sale sites and mining structures are also present.

Early post colonial use in the Thompson Creek watershed involved mining and the cutting of timber for coke production and mine structures (USDA FS, 1999a). Currently mining is the dominant land use in the watershed followed by grazing. Two timber sales totaling 164 acres were harvested on Buckskin Creek in the 1960s. Two additional sales occurred on Pat Hughes Creek to salvage timber on the Thompson Creek molybdenum mine. Other timber sales totaling 417 acres have occurred in the watershed further upstream.

The Thompson Creek molybdenum mine is an open pit mine at the headwaters of Buckskin and Pat Hughes Creeks, and sits on the divide with the Squaw Creek sub-watershed. Total disturbance area in the two sub-watersheds is approximately 2,460 acres (USDA FS, 1999a). There are two NPDES discharges to Pat Hughes Creek and Buckskin Creek, tributaries to Thompson Creek (Mebane, 2000). Past clean metals sampling associated with the mine discharges indicated that total selenium may be slightly elevated in the mine discharge, but no other metals have exceeded chronic criteria (Mebane, 2000).

Further downstream at about 1.5 miles from the mouth of Thompson Creek is an abandoned tungsten milling operation called the Scheelite Jim Mill site. Extensive reclamation of the site was completed in 1992, prior to 303(d) listing. Prior to reclamation work iron hydroxide (also known as yellowboy) deposits existed in Thompson Creek adjacent to the mill site and up to ¼ mile downstream (USDA FS, 1999a). Since reclamation work deposition of iron hydroxide has been greatly reduced, and is only visible over a few feet across from the lower pond adjacent to the reclaimed tailings. Also, as a result of remediation, pH values are consistently below acute and chronic water quality criteria. Steelhead have been observed spawning just below the wetland reclamation project (USDA FS, 2002).

The Thompson Creek tungsten mine, sometimes referred to as the "Scheelite Jim mine" or "Tungsten Jim mine" or "Salmon River Scheelite mine" is located further upstream of the Thompson Creek molybdenum mine near Basin Creek (Van Gosen et al., 2000). This small mine, with two shafts and a single, now collapsed adit, operated during the early 1950s when tungsten prices were unusually high (SAIC, 2000; Van Gosen et al., 2000). The tungsten ore was hauled down 7.5 miles or so to the Scheelite Jim mill site for milling and processing (SAIC, 2000). It is important to note that the 303(d) listed segment of Thompson Creek is from the Scheelite Jim "mill" site to mouth (1.02 miles), not from the mine by the same name which is more than six miles further upstream.

One irrigation diversion structure exists near the mouth of Thompson Creek which has dewatered the stream in the past (USDA FS, 1999a), but is no longer actively used. Private land (100 acres), residential and agricultural, is confined to the lowest reach of Thompson Creek. The Forest Service manages 14,546 acres and the BLM manages 5,173 acres (USDA FS, 1999a).

Slate Creek originates high in the Boulder-White Cloud Mountains and descends northward to the Salmon River falling nearly 6,500 feet (USDA FS, 1999a). The estimated mean annual flow for Slate Creek is 20 cfs, with gradients on Slate Creek and Livingston Creek less than 4%. Other tributaries to Slate Creek are generally greater than 4% gradient. Slate Creek has had sediment debris torrents periodically throughout recorded history. The most recent was on September 6, 1998 as a result of a high intensity rainstorm. A similar event occurred on August 9, 1963, and possibly in 1950-1951, 1934, 1929-1930, and 1840-1860 (USDA FS, 1999a). Despite these periodic natural channel-altering events, Slate Creek and Livingston Creek contain bull trout.

Livestock grazing is the primary activity in the watershed, and there are numerous mining claims although none are active. One inactive hardrock underground mine (Hoodoo Mine) exists in the Hoodoo Creek drainage near the headwaters of Slate Creek.

There are 23,680 acres of Forest Service land in the watershed and 280 acres of private ground, mostly used for agricultural and residential uses (USDA FS, 1999a). Slate Creek receives steelhead trout smolts from IDFG annually and steelhead incubator hatch boxes from the Sho-Ban Tribe (USDA FS, 1999a).

Gardner Creek (partial intermittent) and French Creek (mean annual flow = 3-5 cfs) are dewatered for portions of the irrigation season by an agricultural diversion. Holman Creek (mean annual flow of 5 cfs) had a diversion at one time which has since been removed. There is a culvert at the mouth of Holman Creek that limits fish passage.

Mill Creek (mean annual flow of 3 cfs) flows out onto a large alluvial fan and flows subsurface with no above ground connection to the Salmon River. Peach Creek has two diversions on Forest Service land for agricultural purposes on private land below. Most of these face drainages are steep and may not contain fish populations regardless of diversions (USDA FS, 1999a).

Yankee Fork (303d listed for sediment, habitat alteration)

The Yankee Fork watershed has been divided into three sub-watersheds in Figure 6. For simplicity, the three sub-watersheds will be discussed together here. This watershed includes the Yankee Fork and its tributaries the West Fork Yankee Fork, Ramey Creek, Jordan Creek, Fivemile Creek, Eightmile Creek, and McKay Creek. The entire watershed is within the Salmon-Challis National Forest with several large private land inholdings used primarily for mining activities. Historic stream flow records (1921-1947, Appendix G) show peak discharges from about 600 cfs to as high as 2,750 cfs.

The lower reaches of the Yankee Fork and Jordan Creek were dredge mined in the middle part of the 20th Century. In 1940 a dredge barge was built and dredging for gold proceeded up the Yankee Fork and Jordan Creek until 1952 (covering approximately 13 miles distance). Most of the lower Yankee Fork valley is strewn with rubble piles with scarce vegetation. The Yankee Fork channel is generally consolidated though there are numerous backwater pools in amongst the rubble piles. There is little riparian vegetation to provide shading and instream habitat has been extensively altered. The Shoshone-Bannock Tribes and numerous land management and wildlife agencies have been involved in extensive habitat improvement projects within the Yankee Fork and Jordan Creek watersheds. The Yankee Fork is also presumed to be a major source of sediment to the Salmon River (SNRA, 1999c).

In addition to dredge mining, there are a number of other active and inactive mining operations, including the Grouse Creek Mine owned by Hecla Mining Company. Grouse Creek Mine contains one of several National Pollution Discharge Elimination System (NPDES) permits to discharges in the subbasin. The NPDES discharge is to Jordan Creek, a tributary to the Yankee Fork. This permit is currently in the process of renewal. In December, 2001 IDEQ recognized that significant changes had occurred in the chemistry of the tailing pond solution and the overall status of the closure of the Grouse Creek Facility. The NPDES permit was updated with a letter of amendment from DEQ that incorporated changes into the permit. IDEQ has determined that if Hecla complies with the terms and conditions imposed by the NPDES permit there is reasonable assurance the discharge will comply with the applicable requirements of the Clean Water Act (CWA), including the Idaho Water Quality Standards and Wastewater Treatment Requirements (IDAPA 58.01.02)

Additionally, discharges from a leaking containment pond are being addressed through a consent agreement between the USDA Forest Service, Hecla Mining Company (Hecla) and EPA under the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), formerly referred to as Super Fund. The Administrative Order on Consent for Time Critical Removal Action, EPA Docket No. CERCLA-10-2000-0201, identifies site characterization and implementation of time-critical removal actions under an identified Statement (Scope) of Work (SOW). The objective of the SOW is to reduce concentrations of cyanide and other hazardous substances, pollutants and contaminants to levels that do not result in exceedences of applicable water quality criteria for surface water or ground water. In order to achieve this objective, the main work elements will include dewatering of the tailings impoundment, (removal of tailings impoundment supernatant), recovery of contaminated ground water and closure of the tailings impoundment. A new discharge point will likely be established to the Yankee Fork under that process.

Also in the watershed, Custer, Bonanza, and Sunbeam are place names of small mining settlements. Today there are a number of developed campgrounds within the watershed.

Warm Springs Creek

The Warm Springs Creek sub-watershed includes the Warm Springs Creek drainage from its headwaters in the White Cloud Mountains to the Salmon River at Robinson Bar. This large drainage includes a number of tributaries including Gowan Creek, Line Creek, Gooseberry Creek, Lone Pine Creek, Pigtail Creek, Martin Creek, Bear Lake Creek, Garland Creek, Swimm Creek, and Prospect Creek. Upper Warm Springs Creek, above Pigtail Creek, includes The Meadows, Mountain Home Canyon, Strawberry Basin and Iron Basin. Elevations vary from near 12,000 feet to 6,000 feet. Historic stream flow records (1921-1922, Appendix G) show flows peaking at 600 to 800 cfs with low flows below 100 cfs. The USGS gauge on Robinson Bar, near Clayton, Idaho was discontinued in March 1923. It is assumed that the flow regime has not changed.

The upper portion of the sub-watershed is a glacial carved U-shaped valley. The Meadows are a former glacial lake that has filled with outwash gravels, fine sediments and a thick mat of organic matter from bog-like vegetation development (SNRA, 1999c).

Chinook, steelhead, bull trout, and cutthroat trout have been observed in lower Warm Springs Creek near the mouth (SNRA, 1999c). Chinook and steelhead are believed to have been historically excluded from upper Warm Springs Creek by a falls below the Meadows (SNRA, 1999c). Bull trout and cutthroat trout have been observed in the Meadows area and the mouths of Pigtail Creek and Martin Creek (1992 data). Bull trout were abundant in Martin Creek, cutthroat were present there as well (1993 data).

Surface fines were greater than 30% in assessed reaches in lower Warm Springs Creek. This sediment probably resulted from upstream reaches as well as an intensive thunderstorm in 1998 which caused a debris flow from several eastern tributaries to lower

Warm Springs Creek (SNRA, 1999c). Most assessed reaches in lower Warm Springs Creek, Swimm Creek, and Garland Creek have bank stability greater than 90%.

Of sixteen reaches in upper Warm Springs Creek assessed in 1992, six reaches exceeded 30% surface fines, two reaches were between 26% and 29% surface fines, and the remaining eight reaches were below 25% surface fines (SNRA, 1999c). A high intensity thunderstorm in 1993 resulted in large quantities of sediment delivered to the system. Streambank stability is below 80% in parts of Warm Springs Creek (SNRA, 1999c). Martin and Pigtail Creeks have banks 80-90% stable. Channel entrenchment and confinement occurred in the Meadows sometime in the past, probably resulting from intensive grazing (SNRA, 1999c). Sediment will continue to be delivered to the system from unstable banks until equilibrium is established.

Upper Harden-Big Casino

The Upper Harden-Big Casino sub-watershed includes that portion of the Salmon River from Redfish Lake Creek downstream to Warm Spring Creek. A number of smaller drainages face directly into the Salmon River within this sub-watershed. Some of the larger tributaries include Little and Big Casino Creeks, Rough Creek, and Upper and Lower Harden Creeks.

Numerous chinook and steelhead, and a few bull trout and cutthroat trout have been observed in the Salmon River in this sub-watershed (SNRA, 1999b; 1999c). Cutthroat trout were observed in Upper and Lower Harden Creeks (SNRA, 1999c).

This sub-watershed includes private ground along the Salmon River associated with the towns of Stanley and Lower Stanley. Uses include residential, commercial, agricultural, and recreation. Big Casino Creek has a diversion for agricultural purposes. Spot temperature measurements in the Salmon River show water temperatures as high as 18^{o}C (SNRA, 1999b). No data are available on sediment and bank stability, however, impacts are evidenced by obvious channel widening presumed to be related to historic season-long cattle grazing, channel alteration from Highway 75, and impacts of residential and commercial development within the Salmon River floodplain (SNRA, 1999b; 1999c).

Basin Creek

The Basin Creek sub-watersheds (there are two in Figure 6, both are considered together here) are located on the north side of the Salmon River between Lower Stanley and Sunbeam. Elevations in the drainage vary from 9,100 feet at McGowen Peak to 6,200 feet at the Salmon River. Basin Creek has numerous tributaries including Kelly Creek, Little Basin Creek, Sunday Creek, Duffy Creek, Hay Creek, East Basin Creek, and Coal Creek. Stream gradients vary from as high as 16% in headwaters reaches to 2% in lower reaches (USDA FS, 1998). Flows are typical of central Idaho mountain streams with high flows in May and June from snowmelt runoff and low flows in winter, with occasional flashy responses to summer thunderstorms.

Bull trout were observed in upper Basin Creek, East Basin Creek, Coal Creek, Kelly Creek, and Little Basin Creek and Sunday Creek in 1998 (SNRA, 1999c). Other species such as chinook salmon, steelhead trout, westslope cutthroat trout, mountain whitefish and sculpin are known to exist in the Basin Creek drainage although little is known about their populations (USDA FS 1998).

Water quality and aquatic habitat appear to be in good condition (USDA FS, 1998). Fines at depth averaged between 13.5 to 33% and pool quality is moderate (USDA FS, 2001). Declines in condition resulting from historic uses are recovering. Temperature data taken in 1994 showed water temperatures in excess of 15^{o}C in lower Basin Creek during the summer (SNRA, 1999c). However, subsequent temperature monitoring in 1997 showed only one week of water temperatures over 15^{o}C. The 7-day running average of daily maximum temperature was 20 ^{o}C at the SNRA S-C forest boundary. There is known geothermal inflow into lower Basin Creek.

Currently, cattle have grazed the watershed every other year since 1996. There is evidence of past mining activity throughout the area, and there is currently an active suction dredge proposal in review for use of a portable dredge (USDA FS, 1998). There are approximately 86 miles of road in the sub-watersheds. Primary roads are in the Coal Creek, East Basin Creek and lower Basin Creek areas. Large scale timber harvesting began in the 1960's. Since that time 3,351 acres have been harvested within the sub-watersheds (USDA FS, 1998).

Valley Creek

The Valley Creek drainage is divided among three sub-watersheds, Valley Creek, Upper Valley Creek, and Iron-Stanley. Valley Creek sub-watershed includes that portion of Valley Creek roughly from Elk Creek to its headwaters at Valley Creek Lake. Tributaries within the Valley Creek sub-watershed include Summit Creek, Prospect Creek, Hanna Creek, and possibly McGown and Thompson Creeks.

Valley Creek originates in Valley Creek Lake at an elevation near 8,800 feet in the Salmon River Mountains. The lower end of the sub-watershed, near the mouths of Trap Creek and Elk Creek is dominated by wet meadows characteristic of the entire lower portion of Valley Creek. The sub-watershed contains critical habitat for chinook salmon and steelhead trout (SNRA, 1999a). Additionally, the area is known to contain bull trout and westslope cutthroat trout. Brook trout are the most prominent salmonid in the sub-watershed.

Lower Valley Creek, from Trap Creek to the Salmon River, is dominated by large wet meadows originating from valley bottom glaciation (SNRA, 1999a). Valley Creek valley was carved by glaciers, which left large depressions in the valley floor. These impressions filled with glacial melt water as well as outwash gravels and fine lakebed-type sediments. These numerous lakes eventually filled in with thick vegetation and accumulated organic matter to become wet meadows. Much of this land is privately held

and used for pasturing livestock. Irrigation diversions have been developed to maintain forage vegetation throughout the valley.

The majority of the sub-watershed is in the Salmon-Challis National Forest with the bottom quarter in the Sawtooth National Recreation Area (SNRA). Lower tributaries such as Hanna Creek, McGown Creek and Thompson Creek are within the SNRA. The primary uses in the sub-watershed are grazing and recreation. There are a number of small mining claims spread throughout the drainage, but none are active (SNRA, 1999a). Road densities are generally low (0.8 mi/mi^2 or less), and there have been very few timber cuts. Private lands exist on lower Valley Creek within this sub-watershed, most of which is used for irrigated pasture for livestock grazing. Irrigation diversions exist on many of the lower tributaries including Hanna Creek, McGown Creek, and Thompson Creek. Fish migration connections to Valley Creek have been lost from these tributaries (SNRA, 1999a). Forest Service habitat assessment data show that Valley Creek in this sub-watershed has surface fine sediment in excess of 30% (1992-1993 data) and streambank stability is less than 80% in 10 out of 13 reaches assessed (SNRA, 1999a).

Upper Valley Creek

The Upper Valley Creek sub-watershed includes those tributaries on the west side of Valley Creek above Stanley Lake Creek including Trap Creek, Elk Creek, and Meadow Creek (between Trap and Elk Creeks). These tributaries originate high in the Sawtooth Mountains north of the Sawtooth Wilderness. This sub-watershed is entirely within the SNRA. A population of bull trout were observed in the headwaters of Trap Creek in 1992 (SNRA, 1999a). Other salmonids (Chinook salmon, steelhead trout, cutthroat trout) are believed to be present or were present historically.

Livestock grazing was excluded from this area after 1993 (SNRA, 1999a). Elk Creek near its mouth is diverted in two places for private land use. Road density is very low at 0.1 mi/mi^2. Elk Creek has surface fines generally greater than 20% (1990 data), and Meadow Creek and Trap Creek have surface fines between 26% and 29% (1992-1993 data) (SNRA, 1999a). Bank stability ratings were less than 80% for half the assessed reaches on Elk Creek (1985 data), but were between 80-90% stable on Meadow and Trap Creeks.

Iron-Stanley

The Iron-Stanley sub-watershed includes the lower portion of Valley Creek and its tributaries Iron Creek, Stanley Creek, and Stanley Lake Creek. Additional tributaries include Crooked Creek, Goat Creek, and Meadow Creek (near Stanley). Tributaries on the south side of Valley Creek originate high (near 10,000 feet) in the Sawtooth Mountains within the Sawtooth Wilderness. Many of them contain alpine lakes such as Sawtooth Lake on Iron Creek, Goat Lake on Goat Creek, and McGown Lakes on Stanley Lake Creek.

Stanley Lake Creek is known to contain westslope cutthroat trout above Stanley Lake, and chinook and steelhead below the lake (SNRA, 1999a). Brook trout are found throughout the stream. Chinook and steelhead are commonly seen near the mouths of other tributaries including Iron Creek, Goat Creek, Stanley Creek and Crooked Creek. Bull trout and cutthroat trout are rarely observed in these streams (SNRA, 1999a).

In Stanley Lake Creek, surface fines are generally less than 20% in reaches below Stanley Lake (1992 data) (SNRA, 1999a). Above the lake, sediment levels are apparently very high which results in part from natural conditions. Bank stability was rated as 80-90%, but generally in good condition (SNRA, 1999a). No cattle grazing since 1992 in the watershed and the road density is low at 0.6 mi/mi^2. In other tributaries sediment levels are considered moderate to high. Some of this sediment is from natural sources, although Stanley Creek and Valley Creek itself have been more affected by activities. Lower Valley Creek in the town of Stanley has experienced substantial residential and commercial growth in recent years. There are numerous irrigation diversions on tributaries. Meadow Creek, Goat Creek, and Iron Creek may be dewatered each year (SNRA, 1999a).

Redfish Lake Creek

The Redfish Lake Creek sub-watershed includes Redfish Lake Creek and its major tributary Fishhook Creek, as well as Redfish Lake and Little Redfish Lake. Redfish Lake Creek originates high (10,000 feet) in the Sawtooth Wilderness in a number of alpine lakes including the Upper Redfish Lakes and the Cramer Lakes (Upper, Middle, Lower).

Chinook, steelhead, bull trout, and cutthroat trout have all been observed in Redfish Lake Creek below the lake (SNRA, 1999b). Bull trout are also present in Fishhook Creek as possibly one of two strong populations in the Sawtooth Valley. Redfish Lake remains the only location with returning sockeye salmon, and re-introductions of sockeye to Redfish Lake are on-going.

Sediment, although naturally high due to granitic geology, and bank stability are believed to be within normal parameters (SNRA, 1999b). The primary use within the sub-watershed is recreation. There are extensive developed recreation sites in and around Redfish Lake. An ongoing issue discovered in 2001 is a leaking underground gasoline storage tank near the Redfish Lake Lodge just upgradient from Redfish Lake Creek below the outlet on USDA FS land. This leaking tank has the potential to affect groundwater and surface water as well as migrating Redfish Lake sockeye salmon listed as an endangered species.

Huckleberry-Fisher

The Huckleberry-Fisher sub-watershed includes the Salmon River and a conglomeration of streams tributary to the Salmon River from above Redfish Lake Creek to below Fourth of July Creek. This stretch of the Salmon River includes tributaries such as Huckleberry

Creek/Decker Creek on the west side, and Cleveland Creek, Gold Creek, Williams Creek, and Fisher Creek on the east side.

Snorkel data in 1996 revealed only two cutthroat trout among many brook trout in Fisher Creek (SNRA, 1999b). Chinook and steelhead, and a few bull trout and cutthroat trout have been observed in Gold Creek and Williams Creek.

Fisher Creek appears to have fine surface sediments in excess of 30% in assessed reaches (SNRA, 1999b). Little data is available for Gold Creek and Williams Creek, although lower reaches on private land are believed to have elevated fine sediment and reduced streambank stability (SNRA, 1999b).

Uses in the sub-watershed include historic mining, grazing, residence and recreational homes and outdoor recreation. Gold Creek, Williams Creek, and the last mile of Fisher Creek are dewatered in most years by agricultural diversions (SNRA, 1999b). There are unscreened diversions on Cleveland Creek and Boundary Creek as well.

Hell Roaring-Fourth of July (Lost Creek 303d listed for unknown)

The Hell Roaring-Fourth of July sub-watershed includes the Salmon River, and Hell Roaring Creek and Mays Creek on the western side of the Salmon River, and Champion Creek and Fourth of July Creek on the eastern side. Hell Roaring Creek originates in alpine lakes high in the Sawtooth Wilderness. Champion Creek and Fourth of July Creek originate in alpine lakes high in the Boulder-White Cloud Mountains.

Chinook, steelhead, bull trout, and cutthroat trout have all been consistently observed in the lower reaches of Fourth of July Creek (SNRA, 1999b). Bull trout and cutthroat trout have also been observed in middle reaches as well, however, little is know about the fish in upper reaches of Fourth of July Creek. A few chinook, steelhead, and cutthroat have been observed in Champion Creek, but no bull trout (SNRA, 1999b). Cutthroat trout were the only trout observed in the South Fork Champion Creek. Use of Hell Roaring Creek by sensitive salmonids is unknown (SNRA, 1999b).

Champion Creek and Fourth of July Creek appear to be functioning normally regarding temperature, sediment, and streambank condition, except for the lowest reaches, which appear to have less than 80% streambank stability (SNRA, 1999b). Sediment conditions in Fourth of July Creek may be functioning at risk (26-29% surface fines) in spawning areas due to past mining, grazing and roads in the watershed. Hell Roaring Creek appears to be functioning normally regarding sediment and streambank conditions (SNRA, 1999b). Streambank conditions for the Salmon River in this sub-watershed may be less than 80% stable (SNRA, 1999b).

The lowest reaches of Champion Creek and Fourth of July Creek are in private lands and State lands. There are seven diversions for private land irrigation on Champion Creek and three diversions on Fourth of July Creek. Both creeks are dewatered in lower reaches

in most years (SNRA, 1999b). The primary uses of the Champion Creek watershed are recreation and grazing.

Water temperatures measured in 1994 in the Salmon River and a number of tributaries south of Obsidian in the SNRA produced temperatures in excess of 15^{o}C for several weeks in the summer (SNRA, 1999b). Maximum temperatures exceeded 9^{o}C into September or October of that year. This was apparently a very warm summer which produced warmer than average water temperatures. However, no other temperature data were found for the SNRA portion of the subbasin.

Alturas Lake Creek

The Alturas Lake Creek sub-watershed includes Alturas Lake, Pettit Lake, and Yellow Belly Lake and their associated watersheds. These drainages originate in high elevation, alpine cirque lakes in the Sawtooth Mountains. The drainages above Pettit Lake and Yellow Belly Lake are within the Sawtooth Wilderness. Alpine Creek, a tributary to upper Alturas Lake Creek, is also in the wilderness area.

Sheep grazing and recreation are the predominant present-day land uses in this sub-watershed. Camping and boating are important around Alturas Lake where a number of developed recreational facilities exist including campgrounds, picnic areas, a lodge, and a number of private organization camps. Lower Alturas Lake Creek has several pieces of private land especially at the mouths of Pettit Lake Creek and Yellow Belly Lake Creek.

Alturas Lake Creek is an important seasonal migratory corridor for endangered sockeye salmon and federally protected bull trout and cutthroat trout. Outmigrating sockeye have been observed in this creek since 1980 (SNRA, 1999b). Numerous Chinook salmon and steelhead trout have also been observed near the mouths of Alturas Lake Creek, Pettit Lake Creek, and Yellow Belly Creek. Bull trout and cutthroat trout have been observed in Pettit Lake Creek. There may be an adfluvial population of bull trout in Pettit Lake (SNRA, 1999b). A very important adfluvial bull trout population has been known to exist in Alturus Lake. Numerous cutthroat trout have been observed near the mouth of Yellow Belly Creek, but no bull trout were observed. It is believed that some bull trout may exist above Yellow Belly Lake. The lake itself is managed as a cutthroat fishery (SNRA, 1999b).

Alturas Lake Creek appears to meet Forest Service thresholds for sediment (<20% surface fines) and bank stability (>90%) (SNRA, 1999b). Sediment loads are naturally high in the Pettit Lake Creek and Yellow Belly Lake Creek systems due to granitic geology, but sediment loads and streambank stability are probably functioning normally because of the largely unaltered drainages.

Upper Salmon River

The Upper Salmon River sub-watershed includes the headwaters of the Salmon River, Frenchman Creek, Smiley Creek, and Beaver Creek all originating in the Smokey

Mountains to the south, and Pole Creek originating in the Boulder-White Cloud Mountains to the east. Elevations range from 10,225 feet at Bromaghin Peak to 7,000 feet. Frenchman Creek, Smiley Creek, Beaver Creek and the headwaters of the Salmon River are all parallel drainages running south to north. Pole Creek is a large drainage that runs east to west from the Germania Creek watershed divide.

The Smokey Mountains and Sawtooth Mountains are underlain by granite (Idaho batholith) while the Boulder-White Clouds are a mixture of granitic, sedimentary, and volcanic rocks, creating different soil parent materials between the two sides of the drainage (SNRA, 1999b). In the high elevations cirque lakes feed high gradient headwater streams. Valley bottoms at the north end of this sub-watershed show the U-shaped glacial troughs typical of the Sawtooth valley.

Currently, the most prominent uses in this sub-watershed are recreation and grazing. Cattle, sheep and horse grazing are the primary uses of private land in the Sawtooth Valley at the mouths of these tributaries. Private land is irrigated by diversions from these streams and lower Smiley Creek is dewatered during some years. Past mining activities are evident especially at the headwaters of Smiley Creek (Vienna area) and the Silver King and Pilgrim Mines near the headwaters of Beaver Creek. There are no active mining operations at this time (SNRA, 1999b). Access roads to the Vienna mine are deteriorating and are producing significant amounts of sediment that are ultimately transported by runoff into Smiley Creek. Road densities are generally less than 1.0 mi/mi^2. Timber harvest on public land has been limited, however, on private parcels, access roads and associated harvest activities have increased erosion and sediment delivery to Smiley Creek.

Fish surveys have revealed numerous chinook and steelhead. Bull trout and cutthroat trout are present within the Salmon River, Frenchman Creek, Smiley Creek, Beaver Creek, and Pole Creek (SNRA, 1999b). Numerous brook trout were observed in Pole Creek in 1998, and brook trout are present throughout the upper Salmon River watershed.

Sediment in the Salmon River headwaters, Frenchman Creek, and Pole Creek were rated as “functioning at risk” or between 26 and 29% surface fines due to primarily legacy affects of past grazing and road development (SNRA, 1999b). Bank stability on the Salmon River has been compromised on federal and private land, and is believed to be less than 80% in places (SNRA, 1999b). The Headwaters reach of the Salmon River on SNRA lands above the confluence of Frenchman Creek also exhibits streambank stability less than 80% over some segments. Surface fines were apparently greater than 30% in assessed reaches of Smiley Creek and Beaver Creek due to past grazing, road erosion and mining activities, however, bank stability ratings were greater than 90% on some reaches of Smiley Creek and variable on Beaver Creek (SNRA, 1999b). There is significant aggradation of the stream channel on the middle to upper reach of Smiley Creek, primarily from road erosion on the private in-holdings associated with the Vienna Mine. Aggradation of the Smiley Creek channel will eventually create reduced streambank stability over much of Smiley Creek. Of particular note is the occurrence of a high intensity thunderstorm on July 27, 1998, which delivered considerable amounts of

sediment to the western tributaries of Smiley Creek. This sediment has continued to transport into Smiley Creek. Embeddedness values exceeded 30% in Smiley Creek and Pole Creek in 1985 (SNRA, 1999b).

East Fork Salmon River Sub-watersheds

Spar Canyon

The Spar Canyon sub-watershed is the first major drainage on the east side of the East Fork Salmon River traveling upstream from its mouth. Ninety-six percent of the 23,059 acres in this sub-watershed are administered by the BLM (BLM, 1999a). The State of Idaho owns an additional 892 acres (3.8%), and the remaining 90 acres (0.4%) are private.

Spar Canyon has no perennial tributary streams (BLM, 1999a). Spar Canyon itself is 10 miles of deeply incised ephemeral stream channel that only contains water during spring runoff and during occasional summer thunderstorms. Spar Canyon has a number of ephemeral tributaries and springs including Bear Wallow, Tub Spring, Gossi Spring, White Colt Spring, Grey Stud Spring, and Sorrel Spring. It is likely that Spar Canyon has the potential to contribute significant amounts of sediment to the East Fork of the Salmon River during extreme hydrologic events. The East Fork of the Salmon River would likely ultimately benefit from erosion control measures on Spar Canyon, though the East Fork is not currently §303(d) listed for sediment.

Spar Canyon is used primarily for grazing and secondarily for dispersed recreation. The Spar Canyon road is used to access the lower East Fork of the Salmon River from Highway 93 during all but the winter months.

Big Lake-East Fork Salmon River

The Big Lake-East Fork Salmon sub-watershed includes the East Fork Salmon River from its confluence with the Salmon River to, but not including Big Boulder Creek. This sub-watershed contains Big Lake Creek and a number of smaller drainages, including Joe Jump Basin, Cherry Gulch, Marco Creek, and Bluett Creek on the northwest side of the East Fork Salmon River, and Dry Hollow, McDonald Creek, Fox Creek, Pine Creek, and Baker Creek on the southeast side of the East Fork Salmon River. Big Lake Creek headwaters in the White Cloud Mountains at about 9,800 feet elevation and descends to about 5,800 feet at the mouth.

The East Fork Salmon River descends from about 6,000 feet in elevation near Big Boulder Creek to 5,500 feet at the Salmon River. Historic stream flow records (Appendix G) show annual peak flows from 1,200 cfs to 3,500 cfs. Baker Creek, Pine Creek, and McDonald Creek are perennial streams, Marco Creek, Bluett Creek, and Dry Hollow are intermittent streams, and Cherry Gulch, Joe Jump Basin, and Dry Gulch are ephemeral water bodies (BLM, 1999a). The East Fork Salmon River is known to contain bull trout (BLM, 1999a). Rainbow trout and cutthroat trout are found in Big Lake Creek

above Jimmy Smith Lake, westslope cutthroat trout are found in McDonald Creek, and Pine Creek, however bull trout are absent in McDonald and Pine Creek (USDA FS 2000).

The Big Lake Creek watershed includes 12,818 acres of Forest Service land, 3,654 acres of BLM land, 222 acres of State of Idaho land, and six acres of private land (BLM, 1999a). Perennial water bodies in the watershed include Big Lake Creek, Jimmy Smith Lake, Jimmy Smith Creek, and Corral Creek. Jimmy Smith Lake is a 450 acre natural lake at the confluence of Big Lake Creek and Jimmy Smith Creek. The outlet from the lake has been modified slightly to control lake water levels (BLM, 1999a). Jimmy Smith Lake is a popular recreation spot in summer and is used for ice fishing in winter with rainbow trout the target species.

The sub-watershed is primarily in federal ownership (BLM and Forest Service) with a few State land sections and private land along the river. Land surrounding Jimmy Smith Lake is State owned and managed for recreation (BLM, 1999a). The primary access road parallels the East Fork Salmon River for most of its length, and is paved to about Big Lake Creek. The primary uses in the sub-watershed are grazing and recreation on public lands and agricultural uses on private lands. There are a number of water diversions for irrigated agriculture. The floodplain of the East Fork Salmon River has been highly altered to maintain cultivated lands. Some riparian meadows (e.g. Corral Creek) have been heavily grazed in the past (BLM, 1999a). The area between Marco Creek and Cherry Gulch is maintained as a Bighorn Sheep wintering range, and is excluded from livestock grazing.

Horse Basin Creek (Road Creek 303d listed for unknown)

Horse Basin Creek is a tributary to Road Creek. The sub-watershed should be more appropriately named the Road Creek sub-watershed. The Road Creek drainage, including Horse Basin Creek, contains 50,606 acres of BLM land, 2,911 acres of State land, 409 acres of private ground, and no Forest Service land (BLM, 1999a). Land within the sub-watershed is steep to rolling with narrow valleys, and primarily sagebrush country. Elevations range from 8,400 feet to about 5,400 feet (BLM, 1999a). Tributaries to Road Creek include Horse Basin Creek, Bear Creek, Sand Hollow, and Mosquito Creek, as well as numerous unnamed intermittent and ephemeral tributaries. Sand Hollow is an intermittent stream excluded from livestock grazing because of the erodible volcanic soils in that area (BLM, 1999a). Corral Basin Creek is a tributary to Horse Basin Creek. Rainbow trout and cutthroat trout are present in the sub-watershed, however, no bull trout are known to be present (BLM, 1999a).

Road Creek is paralleled by a gravel road for most of its length. The road is primarily in the 100-year flood plain of Road Creek and makes several creek crossings. There has been very little timber and mining activity in the sub-watershed (BLM, 1999a). The lower three miles of Road Creek is surrounded by private land that is used for irrigated agriculture and grazing. Irrigation diversions dewater Road Creek for much of the irrigation season. Dewatering occurs from the irrigation diversions above the upper boundary of the small lower parcel of BLM lands that the Creek flows through. This is

about 4,800 feet above the confluence with the Salmon and coincides with the western edge of section 19 at N 44º 11.275' W114º 16.339'. Most of the remainder of the sub-watershed is managed for livestock grazing (BLM, 1999a).

BLM reported that water temperatures often exceed state standards in Road Creek, Horse Basin Creek, Bear Creek, and Mosquito Creek (BLM, 1999a). However, maximum water temperature data for 1995 through 1999 showed Horse Basin Creek and Road Creek slightly exceeding 22°C only in 1996, but not in other years (BLM, 1999b, see Appendix C). Thermograph data for 1999 showed that Road Creek did not exceed state standards for temperature. Daily average water temperature in Road Creek below Horse Basin Creek varied between 12° and 14°C from July 8, 1999 to about August 29, 1999. After August 29, 1999 daily average water temperatures drop to 7-10°C. Maximum water temperatures rarely exceeded 19°C at that location in 1999. Riparian condition over all but the dewatered private segment appears to be at full potential. BLM may have been referring to state standards for bull trout as the context was within their biological assessment for bull trout. However, they report no known bull trout populations within the Road Creek sub-watershed.

Herd Creek

The Herd Creek sub-watershed is a large watershed (74,496 acres) located on the south side of East Fork Salmon River. The principle tributaries to Herd Creek include Lake Creek, East and West Fork Herd Creek, East Pass Creek, and Middle Canyon. The majority of the sub-watershed is in the Salmon-Challis National Forest (72% of the drainage basin) with the lowest 4-5 miles of Herd Creek in BLM (24% of the drainage basin), State (3% of the drainage basin) and private ground (1% of the drainage basin).

Elevations in the Herd Creek sub-watershed vary from 10,000 feet to 5,700 feet with an average gradient of 4.2% (USDA FS, 1997a). Herd Creek has mean annual flow of 53 cfs with an average peak of 412 cfs (1983) and a low of 10 cfs. The 96 miles of perennial streams are (91%) source-type channels with gradients greater than 4% (Rosgen A, Aa). The remaining stream channels (6%) are transport-type (Rosgen B, and G gradient = 1.5-4%) and 3% response-type (Rosgen C with F inclusions, gradient <1.5%). Twenty-acre Herd Lake, a popular fishing and camping area, is located on upper Lake Creek at the end of the only major road in the sub-watershed.

Herd Creek is known to contain chinook salmon, steelhead trout, cutthroat trout, bull trout, whitefish, resident rainbow trout, brook trout and sculpin (USDA FS, 1997a). Bull trout are known to be in Herd Creek, West Fork Herd Creek, , and East Pass Creek (BLM, 1999a). Fish passage is blocked 0.5 miles above the confluence of Lake Creek with Herd Creek.

The Forest Service watershed analysis describes Herd Creek as carrying excess sediment. Percent fine sediment in spawning gravel was between 20% and 35%. In 2001 fine sediment at depth in East Pass Creek ranged from 27.1 to 38.3 % and Herd Creek below E. Pass Creek confluence ranged from 28.4 to 32.5% (USDA FS 2001). The range for

the West Fork of Herd Creek was between 20.4 and 27.2% depth fines. The Forest Service standard for fine sediment less than 6.35mm at depth in the Challis zone of the Salmon-Challis National Forest is 30%.

From TSS data it was calculated that Herd Creek can carry 222 tons/day sediment at bankfull and 14.5 tons/day at low flow (USDA FS, 1997a). The watershed analysis (USDA FS, 1997a) rated 65% of the stream reaches as functioning properly, while 27% were functioning at risk but with an upward trend. Only 7% were rated non-functional. Water temperatures in Herd Creek and Lake Creek measured at several locations from 1993 to 1996 show that maximum temperatures rarely exceed 22^{o}C, and often exceed 13^{o}C during the summer months (USDA FS, 1997a). Temperatures varied between sample years with 1994 being the warmest and 1995 the coolest (Appendix C). For example, lower Herd Creek maximum water temperature was 22.4^{o}C in 1994 and 15.5^{o}C in 1995. In other years, maximum temperatures at the same site were intermediate at 16.4^{o}C and 16.5^{o}C for 1993 and 1996, respectively. In 2001 the maximum 7 day average of daily maximum temperature in upper Herd Creek and East Pass Creek was 14.4^{o}C

There are 12 miles of public road, 5.8 miles of abandoned road, 2.4 miles of jeep trails, and 21 miles of non-motorized trails in the sub-watershed (USDA FS, 1997a). There are 246 acres of irrigated agricultural lands with two diversions (five diversion points (USDA FS, 1997a)) totaling 5.48 cfs flow (BLM, 1999a). Grazing is the dominant use in the sub-watershed, followed by recreation.

Sheep-Boulder

The Sheep-Boulder sub-watershed includes the Boulder Creek, Little Boulder Creek, and Wickiup Creek watersheds on the west side of the East Fork Salmon River, and the Sheep Creek and Deer Creek watersheds on the eastern side. Boulder Creek and Little Boulder Creek originate in a complex of high mountain lakes called the Boulder Chain Lakes in the White Cloud Mountains.

The majority of these two watersheds are in the SNRA. The lowest portion of all watersheds extends onto BLM and private ground in the East Fork Salmon River valley. Sheep Creek and Deer Creek extend into Salmon-Challis National Forest. Bull trout are known to exist in Big Boulder Creek and Little Boulder Creek as well as Bowery Creek.

There is one road that travels up Big Boulder Creek and its tributary Jim Creek to access the Livingston Mine area at the headwaters of Jim Creek. Big Boulder Creek has experienced severe “blowouts” of sediment due to activities at the Livingston Mine (BLM, 1999a). Restoration of the degraded stream channel was completed in 1997. These areas were restored through the efforts of the Shoshone-Bannock Tribes and the Bonneville Power Administration. An old dam built on Big Boulder Creek in 1925 was removed in 1991. Private lands used primarily for irrigated agriculture and grazing are found along the East Fork Salmon River. The remainder of the sub-watershed is used for dispersed recreation, with Little Boulder Creek campground near the mouth of Little Boulder Creek being the only developed recreation facility. The Sheep Creek watershed

is also used for livestock grazing. There is an irrigation diversion on Wickiup Creek (BLM, 1999a)

Upper EF Salmon River

The Upper East Fork Salmon River sub-watershed includes the headwaters of the East Fork above Germania Creek. Tributaries to the East Fork Salmon River include Bowery Creek, West Pass Creek, Ibex Creek, and South Fork East Fork Salmon River on the east side of the river, and West Fork East Fork Salmon River on the west side. This sub-watershed originates high (11,700 feet elevation) in the Boulder Mountains from numerous springs and descends northward to about 6,400 feet (BLM, 1999a). Bull trout are known to be present in West Pass Creek, Ibex Creek, South Fork East Fork, West Fork East Fork, and the East Fork Salmon River itself (BLM, 1999a).

The sub-watershed is almost entirely managed by the Forest Service (62,426 acres), with 177 acres of private ground and one acre of State land (BLM, 1999a). Most of this area is within the Sawtooth National Forest and the Sawtooth Natioanl Recreation Area, however, the Bowery Creek drainage is Sawtooth National Forest land administered by the Salmon-Challis National Forest. The entire drainage is used primarily for dispersed recreation. There is one developed recreational facility. There are two private inholdings used for grazing and other agricultural purposes. There are three irrigation diversions at the mouth of West Pass Creek, and one diversion on Bowery Creek. The diversion on Bowery Creek may preclude fish migration in most years (BLM, 1999a). There is one historic mining site in the headwaters of West Pass Creek. There is one road up the East Fork to the Bowery Guard Station site, and another up the West Pass Creek drainage which is apparently washed out, not to be replaced (BLM, 1999a).

Germania Creek

The Germania Creek sub-watershed includes the entire Germania Creek drainage from its headwaters in the Boulder-White Cloud Mountains to the East Fork Salmon River. Elevations range from 11,800 feet to 6,400 feet (BLM, 1999a). The entire 32,000 acre sub-watershed is administered by the SNRA with 100 acres of private inholdings. Tributaries to Germania Creek include Chamberlain Creek, Washington Creek/ Washington Lake Creek, Three Cabins Creek, Galena Gulch, Deer Creek, MacRae Creek, and Alta Creek. Chamberlain Creek, Washington Creek, and Deer Creek all originate in high mountain lakes. Bull trout are known to be present in Germania Creek and Chamberlain Creek (BLM, 1999a).

The upper Washington Creek and Three Cabin Creek drainages, areas known as Washington Basin and Germania Basin, have received considerable mining activity. A road to this region comes across the divide from Pole Creek and extends down Germania Creek to Three Cabin Creek where the road accesses the mining region. The remainder of the sub-watershed is used primarily for dispersed recreation.